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A haptically-augmented interface for digital character animation

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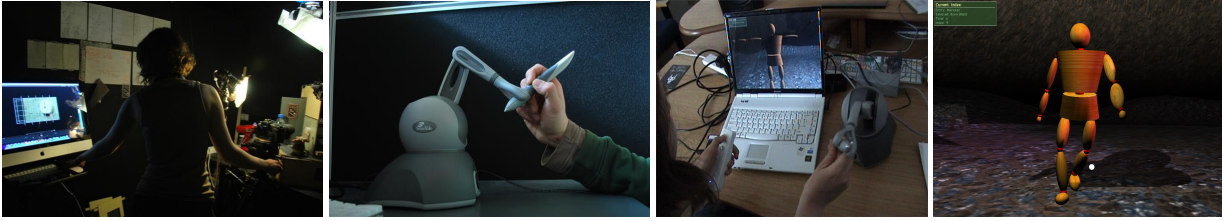


Figure 1: From left to right: The workspace of a stop-motion animator, a haptic device with 6 DoF, one configuration of our system, a screenshot of the digital workspace

1 Introduction

The majority of the commercially available software are accessed through the Windows/Icon/Mouse/Pointer (WIMP) interfaces. Arguably, these interfaces fail to communicate the richness and complexity of human gesture [Scali et al. 2003]. Consequently, embodied skills such as those of creative makers cannot be easily accommodated in digital workspaces. In [Dima et al. 2010] we illustrated this issue in the traditional technique of puppet Stop-motion Animation and, as a first step, explored how puppet stop-motion animators perceive a virtual workspace mounted with the haptic modality and enabling gestural action. The investigation was driven by the development of a new interface system for animating digital 3-D articulated characters designed in collaboration with puppet Stop-motion animators. Hereby, we present further insights on the perception of the virtual workspace derived from the design study on bi-manual interaction. The system itself contributes a new interaction mechanism in the field of Human-Computer Interaction.

2 System Design

The virtual workspace was a $2^{1/2}$ D space on the computer screen mounted with a set of backgrounds and models which could be selected from a drop down menu. A skeleton (or rig), a hierarchical chain of bones and joints, was attached to each virtual character making its movement possible via the implementation of kinematic algorithms. An on-screen animation controller provided information about each captured frame and keyboard buttons were used to set/advance/retrace/swap and delete a frame as well as save or load a sequence of frames.

One 6-DoF stylus-based haptic device, Sensable Omni, was used to manipulate the whole or parts of the virtual character's skeleton as well as the lights and cameras. The device was represented on screen with a sphere which could be moved in three dimensions within the virtual workspace. For the bi-manual interaction study we used two input devices for the actions of the non-dominant hand which were initially assigned to moving the camera: the Wii controller and Connexxion's™ 3D mouse. We tested various setups for the Wii. In the most preferable one, the animators would hold the Wii vertically to the ground. The Wii transferred mimetically to the camera viewpoint the animators' gestures which corresponded to tilting, spinning and rolling, moving up and down. Moving back

and forth, right and left was done by pressing the cross buttons. By pressing the back button the camera would stop moving. A keyboard button positioned the camera in close distance to the character and keeping button 'A' on the Wii pressed would put it in orbit around it. Using this setup, we asked a team of three stop-motion animators to manipulate and animate an articulated 3-D character with no specific time limitations in order to explore how they perceived the virtual environment through haptically-augmented bi-manual work.

3 Results

In [Dima et al. 2010] we discussed the difficulty the animators had in perceiving the virtual space in relation to how they moved the haptic device's representation in it. We explored the solution of providing visual cues (e.g. visual markers on the selected bones) which led to the observation that visual and haptic cues provide greater perception of space and ease its navigation. The bi-manual interaction study revealed ways of improving their perception of the space kinaesthetically.

Although the Wii was considered to be a less static device in comparison to the 3D mouse, the animators would prefer neither of the two for camera manipulation. They suggested that this task could be carried out with the haptic controller in the dominant hand using the device's buttons on the stylus to switch between camera navigation and character manipulation. The controllers, and particularly the Wii, could instead be used to move or rotate the whole character while the dominant hand would use the haptic device to perform the subtle manipulation of the character's skeleton parts. We found that this method improved their perception of the virtual space as opposed to having both hands working in different things without being co-located, even roughly, on the virtual space. In addition, the animators occasionally felt that the sense of touch that the device recreated assisted them in navigating around the skeleton's structure and in understanding the position of the device's representation during navigation.

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